June 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

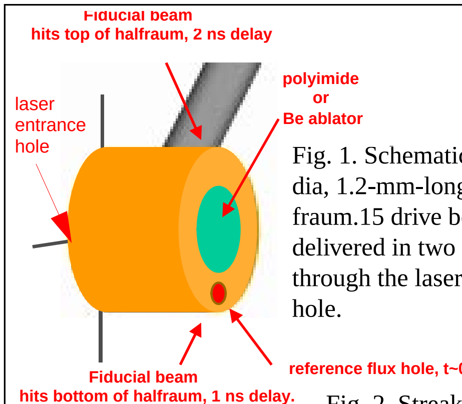

Fig. 1. Schematic of 1.6-mm-dia, 1.2-mm-long Omega halfraum.15 drive beams are delivered in two cones through the laser entrance hole.

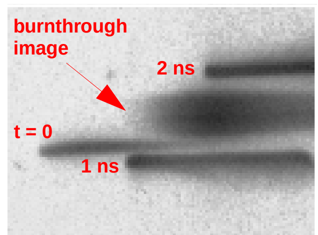

Fig. 2. Streaked images of 550-eV x rays on Omega Shot 20162. A detailed lineout through the image indicates that burnthrough of the polyimide sample is within ~200 ps of the integrated preshot prediction with 2-D Lasnex.

The specific recommendations to Sandia management by the 15-member external panel, headed by Dick Garwin, that reviewed our pulsed power programs on May 17 - 19 include: 1) enhancing the capabilities of Z should remain a key focus; 2) constitute and actively maintain a formal Z users' group; 3) exploiting Z for equation of state and material physics research can bridge the gap between gas gun and laser facilities and ensure that investments in advanced simulations are properly utilized for stockpile stewardship; 4) pursue an upgrade to Z, to 30 MA, without reducing the number of shots; and 5) Sandia's high-yield physics program involving hohlraum studies and capsule implosions constitutes effective support of the National Ignition Facility (NIF). The panel recommended to DOE that a high-energy-density-physics overview committee be chartered to examine the overall effectiveness of ICF and weapon science programs at the national laboratories.

We had 12 Z shots. These were 2 LANL weapon physics shots, 2 z-pinch power flow shots to test a new wire array design that should reduce the error in anode-cathode gap alignment, a short circuit shot, 4 shots to optimize the axial x-ray output from a hohlraum for future weapon physics experiments, and 2 Defense Threat Reduction Agency shots to develop a radiation effects source from molybdenum-L-shell x rays.

Indirect-drive ignition of a NIF capsule could fail if burnthrough of the ablator cannot be predicted to within a few percent. If the ablator is too thick, the implosion velocity will not be large enough; if it is too thin, the drive will burnthrough the ablator and cause excessive fuel preheat. On June 13, we did four experiments on Omega at the University of Rochester (UR) designed to provide code verification of ICF ablator burnthrough timing. The experiments, led by us, were done in collaboration with LANL, LLNL, and UR. We obtained indirect-drive burnthrough data for polyimide and beryllium samples using a halfraum geometry (Fig. 1) that is compatible with meeting the IDI2 Level-1 milestone of the ICF Campaign to select the optimal indirect-drive ignition targets for the NIF and with WBS-3 plans for first-bundle shock-timing measurements on the NIF. As shown in Fig. 2, two timing fiducial beams on Omega provided an accurate time-tie of each pixel in the image to the laser pulse. We can therefore use the time of burnthrough to compare the data with the predictions of 2-D Lasnex simulations.

The goal of the high-yield assesssment part of the ICF Campaign is to develop a credible scenario for high yield with z pinches by validating the key physics of the driver and target design. A high-yield facility, as a follow on to the NIF, could enhance the weapon science database and also pave the way to expand the nation's energy options. Our Level-2 milestone for FY00 (HYA1.1) is to supply the initial designs for two z-pinch hohlraum concepts, based on 2-D code simulations and analytic models. We have developed an analytic scaling model for the dynamic hohlraum and are quantifying the effect of radiation asymmetry caused by the magnetic Rayleigh-Taylor instablity in integrated 2-D Lasnex simulations on a four-processor DEC ES-40. For the z-pinch-driven hohlraum, we are quantifying the sensitivity of the capsule yield to even (hohlraum geometry) and odd (pinch power balance and simultaneity) modes of radiation asymmetry.

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Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.